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RESEARCH ARTICLE

COMPETING PERSPECTIVES ON THE LINK BETWEEN STRATEGIC INFORMATION TECHNOLOGY ALIGNMENT AND ORGANIZATIONAL AGILITY: INSIGHTS FROM A MEDIATION MODEL[1]

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Strategic information technology alignment remains a top priority for business and IT executives. Yet with a recent rise in environmental volatility, firms are asking how to be more agile in identifying and responding to market-based threats and opportunities. Whether alignment helps or hurts agility is an unresolved issue. This paper presents a variety of arguments from the literature that alternately predict a positive or negative relationship between alignment and agility. This relationship is then tested using a model in which agility mediates the link between alignment and firm performance under varying conditions of IT infrastructure flexibility and environmental volatility. Using data from a matched survey of IT and business executives in 241 firms, we uncover a positive and significant link between alignment and agility and between agility and firm performance. We also show that the effect of alignment on performance is fully mediated by agility, that environmental volatility positively moderates the link between agility and firm performance, and that agility has a greater impact on firm performance in more volatile markets. While IT infrastructure flexibility does not moderate the link between alignment and agility, except in a volatile environment, we reveal that IT infrastructure flexibility has a positive and significant main effect on agility. In fact, the effect of IT infrastructure flexibility on agility is as strong as the effect of alignment on agility. This research extends and integrates the literature on strategic IT alignment and organizational agility at a time when both alignment and agility are recognized as critical and concurrent organizational goals.

Keywords: Agility, strategic IT alignment, environmental change, volatility, IT infrastructure flexibility, IT rigidity traps, industry clockspeed

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Introduction

After two decades of extensive research and debate, strategic IT alignment, defined as the extent of fit between information technology and business strategy, remains a top priority for information systems researchers and practitioners.[2] Studies have repeatedly found that alignment affects profit, productivity, sales growth, and reputation, prompting firms to consider efforts to further increase the extent of fit between IT and business strategy (Chan et al. 1997; Chan et al. 2006; Oh and Pinsonneault 2007; Preston and Karahanna 2009; Tallon 2008).

At the same time, a marked increase in environmental volatility due to greater uncertainty in international financial markets, volatile consumer demand, and rapid product obsolescence has led firms to consider their ability to respond to change. Faced with rapid and often unanticipated change, agility, defined as the ability to detect and respond to opportunities and threats with ease, speed, and dexterity, has emerged, next to alignment, as a key business imperative. Agility has also garnered significant attention from a broad spectrum of IS researchers (Galliers 2007; Hitt et al. 1998; Overby et al. 2006; Rai et al. 2006; Sambamurthy et al. 2003; Weill et al. 2002).[3]

Although firms now view alignment and agility as concurrent goals, researchers have yet to integrate the alignment and agility literature as a way to assess how these two objectives might be achieved. Our knowledge and understanding of how, or if, alignment and agility are related is limited. Each area of literature evolved separately and remains so today. Hence, the literature has largely overlooked agility as a potential outcome of alignment, focusing instead on standard firm performance metrics such as profit, growth, and efficiency (Oh and Pinsonneault 2007). Equally, the literature on agility has focused on conceptual concerns and, more recently, on the benefits of agility rather than on whether increased alignment can help or hurt agility.

A careful review of the strategic management and organizational studies literature reveals a series of contradictory knowledge and resource-based arguments supporting both a positive and negative association between alignment and agility. Knowledge sharing and associated behaviors among IT and business executives are an enabler of alignment and an important factor in sensing environmental threats and opportunities before deciding if, how, and when firms should respond (Gibson and Birkinshaw 2004; Preston and Karahanna 2009; Reich and Benbasat 1996). If this is correct, then alignment could help agility. However, knowledge sharing is also claimed to foster myopia and a desire to protect the status quo. Such behaviors place the exploitation of existing resources ahead of the exploration of new opportunities, potentially hurting agility (Ghemawat and del Sol 1998; Gibson and Birkinshaw 2004). Once firms achieve alignment—especially if this involves a large-scale, multiyear IT investment or significant managerial personal effort—firms may prefer to maintain a state of stable equilibrium, extracting as much value as possible from their existing IT investments (sunk cost) and making as little change as possible to IT or business strategy. The net result is that firms may downplay the need for change or the opportunity costs of failing to be agile since they have a vested interest in securing the status quo (Jarvenpaa and Ives 1994). From a resource viewpoint, the pursuit of alignment requires IT to be deeply embedded in key business activities, the same activities that may likely change if environmental forces call for a rapid shift in strategic focus. Having IT resources in close proximity to activities that need to change allows for rapid responsiveness to change (Allen and Boynton 1991). Paradoxically, embedding IT deeply within business activities can also lead to excessively automated, routinized, simplified, and rigid activities that hurt agility by limiting a firm's strategic choices (Bharadwaj 2000; Henderson and Clark 1990; Sanchez 1995). Indeed, such is the fear that increased alignment could restrict agility that researchers have begun to consider a tradeoff between short-term performance benefits from alignment and long-term benefits from agility (Jarvenpaa and Ives 1994). There may equally be a tradeoff between resource commitment to current goals and the ability to adapt those goals based on shifting market needs (Ghemawat 1991; Gibson and Birkinshaw 2004; Leonard-Barton 1992).

Given these two competing perspectives and the absence of empirical research to resolve this dispute, the current study seeks to determine whether in fact alignment helps or hurts agility. We do so by placing both constructs in a nomological network predicting firm performance. This allows us to test the direction of the relationship between alignment and agility but it also allows us to evaluate if agility mediates, fully or partially, the relationship between alignment and firm performance. Insights obtained from mediation can show whether the total effect of alignment on firm performance is increased, decreased, or simply unaffected by the empirically determined direction and strength of the link between alignment and

[2]For ease of expression, we refer to strategic IT alignment as *alignment* and to organizational agility as *agility*.

[3]Sambamurthy et al. (2003) divide agility into three dimensions: customer agility (co-opting of customers as a way to gain market intelligence), partnering agility (learning from business partners as a way to increase speed to market), and operational agility (process redesign for increased speed and efficiency). In this paper, our use of the term agility reflects the totality of these dimensions; we later operationalize agility using these same three dimensions.

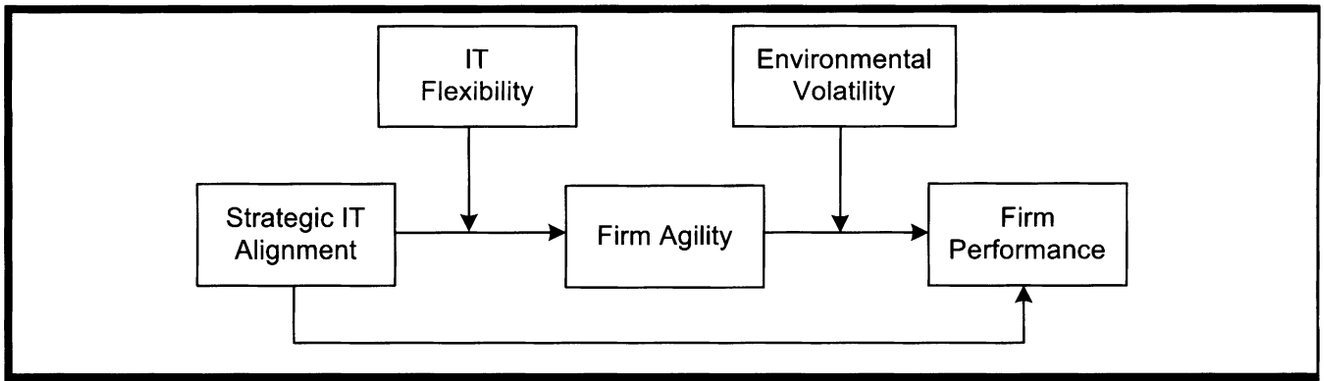

Figure 1. Conceptual Model

agility and between agility and firm performance. We also consider the conditions under which alignment might help or hurt agility. First, we consider the moderating effect of IT infrastructure flexibility, defined as the extent to which key IT resources can scale and adapt for different purposes (Byrd and Turner 2000). To the extent that firms have deployed flexible hardware, software, and networks that can scale as the demand for strategic IT support changes or that can adapt to changes in data formats, operating requirements, and information needs, alignment may be less likely to hurt agility. In fact, if alignment enables agility, a flexible IT infrastructure could help to accelerate the pace with which alignment can bring about a desired change in agility.

A second potential moderating factor is environmental volatility, defined as the frequency and extent of change in critical market variables (Dess and Beard 1984). Environmental volatility ranges from relative calm in firms with a particularly slow rate of new product innovation, where demand is static, and customer turnover is low to extreme volatility in areas such as the high-tech sector where product life cycles are short, where demand is volatile, and where customer turnover can be extreme. Depending on the extent of environmental volatility, agility could have different effects on firm performance. Agility in a stable environment may be less inclined to benefit firm performance to the same extent as when market conditions are highly volatile and unpredictable. We summarize these various relationships in our conceptual model shown in Figure 1.

This study contributes to the evolving literature on alignment and agility in four respects. First, by integrating different aspects of the literature, we develop two rival perspectives on the link between alignment and agility. The resulting theoretical arguments can yield further insights into the economic impacts of IT. Second, in analyzing data from a matched survey of executives in 241 firms, we find that alignment is positively associated with agility; there is *no evidence* that alignment hinders agility even in cases where IT infrastructure flexibility is low. Third, in testing for moderation effects, we reveal that IT infrastructure flexibility is as much an enabler of agility as alignment. One interpretation of this is that while alignment allows IS and business executives to identify opportunities for IT to help agility, IT infrastructure flexibility is what will ultimately execute these opportunities. Fourth, we find that agility fully mediates the effect of alignment on firm performance. Thus, while alignment remains a key factor in driving firm performance, firms must not ignore how the factors that help bring about alignment might also help to create agility.

The remainder of this paper is arranged as follows. We first consider the theoretical foundations of our model, synthesizing a diverse body of literature to present two competing perspectives on the link between alignment and agility. Next, we introduce our methodology and data, drawn from a matched survey of IS and business executives in 241 firms. After discussing our results and their broader implications for IS research and practice, we conclude by assessing the limitations of our research and suggesting potential avenues for future research.

Theoretical Development

Alignment and Firm Performance

Table 1 outlines earlier research on strategic IT alignment. Two main observations can be reached from reviewing Table 1. First, despite differences in approaches and conceptualizations, the evidence indicates, with few exceptions, a strong positive association between alignment and firm per-

Table 1. Synthesis of Strategic IT Alignment Literature

Reference	Particulars of Alignment	Approach	Characterization of IT	Research Findings
Sabherwal & Kirs (1994)	Alignment of critical success factors and IT capabilities in a university	Profile Deviation (Firm level)	IT capabilities are based on information retrieval, electronic communications, computing facilities, and computer-aided education	Alignment is associated with perceived IT success and organizational performance
Chan et al. (1997)	Alignment of eight dimensions of strategy, based on STROBE (Venkatraman 1989) with eight similar dimensions of IS strategy	Moderation (Process level)	IT strategy is modeled via a STROEPIS framework that rates the extent of IT use in support of business activities that focus on aggressiveness, analysis, internal defensiveness , external defensiveness, futurity, proactiveness, risk aversion, and innovativeness	Alignment has a positive impact on the perceived performance of the firm and on the perceived effectiveness of the IS unit
Palmer & Markus (2000)	Alignment between supplier, internal, and customer focused business and IT strategies	Matching (Firm level)	IT strategy is based on IT use in support of supplier partnering, transaction efficiency, or customer detail	Alignment is not correlated with retail-specific measures of firm performance
Croteau & Bergeron (2001)	Alignment of strategy, based on the Miles and Snow (1978) typology, with IT deployment profiles	Covariation (Firm level)	IT deployment is a latent variable modeled by six indicators: strategic impact of the IS department, management style of IS teams, IT architecture, IT scanning, source of IS development, and IS performance evaluation	Technological deployment by defenders is contrary to their strategic focus
Croteau et al. (2001)	Alignment of organizational and IT infrastructure	Covariation (Firm level)	IT infrastructure is a latent variable modeled by five indicators: user involvement, connectivity, distributed computing, flexibility, and IT awareness	Alignment between organizational and IT infrastructure predicts firm performance
Sabherwal & Chan (2001)	Alignment is based on the difference between actual and ideal levels of IT use for strategies based on the Miles and Snow (1978) typology	Profile Deviation (Process level)	IT strategy is determined through a STROEPIS framework. It evaluates the extent of IT use in supporting business activities around aggressiveness, analysis, internal and external defensiveness, futurity, proactiveness, risk aversion, and innovativeness	Alignment leads to higher performance in all firms, except in the case of defenders
Kearns & Sabherwal (2003)	Alignment is based on cross-referencing of IT and business plans	Covariation (Firm level)	The IT strategy is not measured directly. Instead, the focus is on the creation and content of an IT planning document	Cross-referencing of the business plan in the IT plan is consistent with use of IT for competitive advantage
Bergeron et al. (2004)	Alignment between business and IT strategy, IT and business structure	Gestalt (Firm level)	IT strategy reflects measures of strategic use of IT and environmental scanning; IT structure is based on IT planning, control, acquisition, and implementation	Alignment is positively related to firm performance
Chan et al. (2006)	Alignment is based on the difference between actual and ideal levels of IT use for strategies based on the Miles and Snow (1978) typology	Profile Deviation (Process level)	Uses STROEPIS to reflect IT use in support of business strategy; data drawn from Chan et al. (1997) and Sabherwal and Kirs (1994)	Alignment is positively related to performance for all firms except in the case of defenders
Oh & Pinsonneault (2007)	Alignment between business and IS strategy based on a resource-centered and contingency perspective	Matching, Moderation (Firm level)	IT strategy was operationalized using a portfolio of IT applications that were defined as having an operational, quality or revenue growth orientation	Alignment is associated with lower costs, higher sales and profit
Tallon (2008)	Alignment between business and IT strategy across five processes: supplier relations, production/operations, product/service enhancement, sales/marketing, and customer relations	Moderation, Profile Deviation (Process level)	IT use was assessed in each of five business processes across the value chain	Alignment is associated with higher IT business value for firms except those that espouse a strategy of operational excellence

formance. Alignment has been found to improve performance in general (Bergeron et al. 2004; Chan et al. 1997; Croteau et al. 2001; Kearns and Sabherwal 2007; Oh and Pinsonneault 2007; Zahra and Covin 1993) and in critical areas such as market growth, financial performance, innovation, and reputation (Chan et al. 1997), growth and income (Croteau and Bergeron 2001), and cost control (Oh and Pinsonneault 2007). More recently, Tallon (2008) examined alignment at the process level (past research tended to operationalize alignment at the firm level) and found that it was positively correlated with IT business value at the process level. Tallon (2008) reports also that the primary locus of alignment within the firm (the process where alignment is highest) varies based on differences in strategic foci and so alignment is rarely the same in any two firms.

Second, moderators are playing an increasingly important role in the study of alignment. For example, research has found important differences in alignment based on the type of strategy adopted by firms. Defenders under the Miles and Snow (1978) typology reap little or no financial gain from alignment (Chan et al. 2006; Sabherwal and Chan 2001); operationally excellent firms under the Treacy and Wiersema (1995) typology are also unaffected (Palmer and Markus 2000; Tallon 2008). Based on recent research on the resource-based view of the firm, attention has also turned to considerations of IT resources. Hardware, software, and networking decisions can vary significantly from company to company even if the extent of fit between IT and business strategy is identical in each case (Wade and Hulland 2004). In our review of the alignment literature, only two studies considered the potential role played by IT flexibility in allowing alignment to have a greater effect on firm performance (Croteau and Bergeron 2001; Croteau et al. 2001). In both of these studies, IT flexibility is seen as a dimension of IT strategy and is, therefore, an inseparable part of alignment rather than a moderator of the alignment–performance relationship. Regardless of moderation effects, the argument remains, as previously noted in the literature, that alignment is positively associated with firm performance. This suggests the following hypothesis:

H1: The extent of alignment between IT and business strategy is positively associated with firm performance.

Alignment and Agility

While little is known empirically about the effect of alignment on agility, there is a growing body of research in the organizational studies and strategic management literature on the link between knowledge creation, sharing, use, and agility. There is also an evolving literature on the subject of ambidexterity, representing "the capacity to simultaneously achieve alignment and adaptability at a business-unit level" (Gibson and Birkinshaw 2004, p. 209) while other studies describe a series of tradeoffs or conflicts between exploration and exploitation of organizational resources or between commitment to current business goals and the ability to adapt those goals when faced with sudden and often unexpected change. Based on this literature and the current IS literature on strategic IT alignment, we develop two competing perspectives on the link between alignment and agility. Table 2 shows the reasoning behind each perspective and their respective predictions for how alignment facilitates or impedes agility.

Alignment Facilitates Agility

Previous research shows that a shared understanding of IT, knowledge sharing between IT and business executives, and a shared language for describing IT are important antecedents of alignment (Kearns and Lederer 2003; Preston and Karahanna 2009; Reich and Benbasat 1996). Knowledge sharing facilitates collaboration between IT and business executives, making it easier for firms to detect change before deciding a joint course of action for how best to respond (Barki and Pinsonneault 2005; Lee 2004). The resulting alignment between IT and business strategy can enable agility since essential changes in business strategy can be easily communicated to IT executives while the potential for IT-led capabilities to redirect business strategy can be shared with business executives. In this way, the path dependencies and routines provided by alignment can enable increased adaptiveness and innovation (He and Wong 2004; Lavie and Rosenkopf 2006; Zahra and George 2002). This type of collaboration can create a virtuous cycle as the search for new IT and business opportunities creates new knowledge that can be shared with suppliers, customers, and key business partners—relationships that are often a necessary part of how firms react to change (Lavie and Rosenkopf 2006). Mindfulness, alertness, IT innovation, and opportunistic search mean that alignment is built on a foundation of inclusive decision making that is fully supportive of agility (He and Wong 2004; Kraatz and Zajac 2001; Pinsonneault and Kraemer 2002). Responsiveness to change can often mean having to coordinate activities across different business units or functions (Sambamurthy et al. 2003). The integration of IT across business units eliminates barriers to consensus that can impede agility (Pinsonneault and Kraemer 2002). Language barriers refer to the inability of senior management to articulate and communicate their knowledge and logic so their positions are understood and accepted by others. By standardizing language across business units, alignment can curb or eliminate

Table 2. Two Competing Perspectives on the Link between Alignment and Agility

	Strategic IT Alignment Facilitates Agility	Strategic IT Alignment Impedes Agility
Anticipated Impacts		
Alignment on Agility Agility on Firm Performance	Positive Positive	Negative Positive
Underlying Arguments		
Knowledge Creation, Sharing, and Use	Alignment is a product of shared understanding between IT and business managers (Kearns and Lederer 2003; Preston and Karahanna 2009; Reich and Benbasat 1996). IT and business activities are designed in a way that allows firms to gather environmental knowledge, to share that knowledge across business units, and to react to change in a more informed, aggressive, directed, and agile manner (Barki and Pinsonneault 2005; Gibson and Birkinshaw 2004; Lavie and Rosenkopf 2006; Lee 2004; Levitt and March 1988; Zahra and George 2002).	Shared understanding is useful but it may be based on what worked in the past rather than what might work in the future if the firm is forced to respond to environmental change (Christensen 1997). Alignment can foster behavioral inertia, tunnel vision, intransigence, path dependencies, and routines that undermine firms' responsiveness to change (He and Wong 2004; Kraatz and Zajac 2001; Lavie and Rosenkopf 2006; Miller 1993; Nelson and Winter 1982; Sabherwal et al. 2001).
Resource Selection, Use, and Commitment	Alignment calls for IT to be embedded in key business processes. The close degree of resource proximity to these processes can facilitate rapid responsiveness to change (Tallon 2008). Alignment bundles IT with other resources in a way that promotes consideration of how existing resources can be stretched to enhance current performance or how they can be used in new ways to prepare for change or to react to change (Bharadwaj et al. 1999; Oh and Pinsonneault 2007; Soh and Markus 1995). Alignment-induced exploration and exploitation of key organizational resources stimulates innovation and adaptation (Gupta et al. 2006; He and Wong 2004; Kraatz and Zajac 2001).	Alignment calls for long-term resource commitment and bundling that is consistent with an intent to maintain the current strategic direction (Burgelman 1994; Kelly and Amburgergey 1991; Lavie and Rosenkopf 2006; Rothaermel 2001). Firms may prefer to realize value from these resources before sanctioning any change. Alignment-induced exploitation and exploration of key organizational resources encounter competency traps that slow the rate of innovation and responsiveness to change (Andriopoulos and Lewis 2009; Gupta et al. 2006; He and Wong 2004; Henderson and Clark 1990; Leonard-Barton 1992; Levitt and March 1988; Sanchez 1995).

language barriers that might cause confusion or otherwise delay and impede agility (Preston and Karahanna 2009).

Various resource-based arguments also point to a positive relationship between alignment and agility. Key resources must be sourced and deployed in order to execute whatever changes to IT or business strategy are necessary. Knowledge-sharing, as noted earlier, allows firms to better understand their resource needs and potentially the limitations of their resources but it could also motivate executives to move resources to areas of the business that are most likely to experience change. Having resources embedded in business processes and in close proximity to the locus of change means that, besides facilitating alignment, firms are more likely to be agile in responding to change (Tallon 2008). The lead time required to mobilize additional resources or to transform existing resources will be greatly reduced if those resources are already understood and in place.

The organizational studies literature has, in recent years, explored the question of whether it is better to exploit existing resources or to explore new opportunities for using those resources. Either way, agility is a likely beneficiary. Alignment-induced exploitation of resources can foster the creation of important IT capabilities in an atmosphere of continuous improvement (Gupta et al. 2006; He and Wong 2004). Alignment-induced exploration can also motivate firms to explore potentially disruptive ways of using resources to proactively create change rather than reacting to it. Although some of these efforts could end in failure, the drive to innovate and adapt means that firms are not only using resources to create tight alignment between IT and business strategy, but they are doing so in a way that is enabling of agility (He and Wong 2004). IT use, a primary element of alignment (Chan et al. 1997; Sabherwal and Chan 2001; Tallon 2008), can facilitate learning that promotes agility by helping individuals to identify new uses for existing IT resources or how IT resources can be combined with non-IT resources in new and innovative ways (He and Wong 2004; Pinsonneault and Rivard 1998). Finally, a nascent body of research claims that firms can be ambidextrous in pursuing alignment and agility at the same time (Andriopoulos and Lewis 2009; Cao et al. 2009; Gibson and Birkinshaw 2004). As such, alignment and agility are not mutually exclusive. Decision making is not marked by tradeoffs between short-term gains from alignment and long-term gains from agility. Instead, organizational capabilities that create alignment are the same capabilities that allow alignment to foster improved agility (Rindova and Kotha 2001).

IT Alignment Impedes Agility

A second perspective can be extracted from the literature, offering a rival view of the relationship between alignment and agility. Knowledge and resource-based arguments that had earlier claimed that alignment helps agility are just as likely to suggest the reverse. This alternative perspective argues that while knowledge sharing, common language, and shared understanding help to develop alignment between IT and business strategy, the body of knowledge, language, and understanding held by executives can come from what has worked in the past. Success can trick firms into believing that their current strategic trajectory is right for the future whereas market change may necessitate an entirely new direction (Christensen 1997).

While knowledge sharing can help create a solid IT–business partnership, that partnership can paradoxically impede agility in two ways. First, executives may be uncomfortable in pushing back against their IT or business partners for fear of upsetting their relationship; it may be easier and more politically astute to go with the flow even if this is not in the best long-term interests of the firm (Miller 1991). If alignment is obtained on the basis of knowledge that worked well when market change was not an issue, the risk is that a myopic approach to alignment will discount the risk of change or the downside of failing to react in time. The same logic applies to group-think. Consensus can be critical when building alignment but not if it excludes contrarian viewpoints or isolates those who may be better able to detect change (Janis 1982; Starbuck and Milliken 1988). Second, successful alignment builds credibility for firms that may then feel compelled to realize as much value as possible from their current alignment configuration before changing their IT or business strategy to reflect a new market reality. Even if the signs of market change are clear and unequivocal, managers might still not react, preferring to delay as long as possible (Choo 2005). Equally, in an effort to maintain a strong IT–business partnership, business executives may prefer to delay requests for new IT investment or for new features and functions to be added to existing applications. CIOs may not want to force new IT on users until there is a clear and pressing need. In effect, each side is committed to protecting alignment or the status quo and so firms may later struggle to respond to change (Howe 2008; Reich and Benbasat 2000; Surowiecki 2005). Thus, if knowledge sharing motivates firms to maintain the status quo, alignment could impede agility.

From a resource standpoint, alignment can also create competency traps that stifle agility. Given the high sunk cost and low disposal value of IT resources, executives may prefer to direct their attention to using IT to deliver direct and immediate value rather than using those resources to explore new market opportunities with no guarantee of a return (Gupta et al. 2006; Kraatz and Zajac 2001). Based on this level of resource commitment, the default response to change may be to protect the status quo in the hopes that whatever changes are occurring in the environment are temporary and reversible. The risk, however, is that resources that were once key to supporting a core competence can, in a new market, become a core rigidity (Bharadwaj 2000; Leonard-Barton 1992). If resources are deployed based on their ability to protect the status quo, alignment could still benefit firm performance in the short term but potentially at the expense of long-term agility.

Although the ambidexterity literature states that firms can be aligned and adaptable at the same time, other studies point to an underlying resource-based conflict between exploitation and exploration (Ghemawat and del Sol 1998; He and Wong 2004; Lavie and Rosenkopf 2006). The push for internal fit

between strategy, structure, IT, and processes is seen as contrary to the desire for external fit between strategy and the environment (Miller 1992). To the extent that resources are used to support an existing business strategy, firms with strong internal fit have been found to have weak external fit and vice versa (Miller 1992). Research shows that firms tend to commit to a single strategic focus since firms with multiple foci or those lacking a clear focus realize lower firm performance (Porter 1980; Tallon 2007; Treacy and Wiersema 1995; White 1986). As such, firms tend to commit resources such as IT, knowledge, skills, and leadership to a single strategic focus (Eisenhardt and Martin 2000; Ghemawat 1991; Leonard-Barton 1992; Miller 1992; Teece et al. 1997). If market change calls for firms to pursue new activities or to revise the entire focus of their business strategy, they may have to unlearn and abandon known ways of doing business, unbundle resources, learn new ways of doing business, and re-bundle resources. The net effect is that alignment may be overly restrictive of agility as specialized resources are tightly aligned to a well-defined business strategy that, when faced with market change, is itself forced to change.

In summary, the two perspectives distilled from the literature offer conflicting predictions for the direction of the relationship between alignment and agility. We highlight these competing predictions in the following pair of hypotheses:

H2a: *Alignment between IT and business strategy is positively associated with agility.*

H2b: *Alignment between IT and business strategy is negatively associated with agility.*

The Moderating Effect of IT Flexibility

IT infrastructure flexibility encompassing hardware, software, and networks could have a positive moderating effect on the link between alignment and agility. That is, firms with similar levels of alignment between their IT and business strategy could have different agility depending on their respective IT infrastructure flexibility. Under the two rival perspectives that describe the link between alignment and agility, IT flexibility could further increase an already positive effect of alignment on agility or it could decrease some of the negative effects of alignment on agility.

Two specific properties of a flexible IT infrastructure—scalability and adaptability—help to explain these positive moderating effects (Allen and Boynton 1991; Byrd and Turner 2000; Sambamurthy et al. 2003; Wade and Hulland 2004; Weill et al. 2002). Scalability represents the extent to which IT capacity can expand or contract. Scalability, in practice, means that firms can add or remove hardware capacity (servers, storage, routers, CPUs), software licenses, or network bandwidth easily and quickly. Scalability can be achieved in two ways: by building or acquiring additional resources such as server farms or by using more recent technologies such as software-as-a-service or grid computing. Adaptability refers to the extent to which an IT infrastructure can support different IT needs. Adaptability can be pursued through ERP systems or middleware that integrates data from different best of breed applications, allowing information to flow seamlessly to users. Adaptability also pertains to interoperability of data structures and formats and whether applications can be ported to different operating systems without undergoing translation.

Conceptually, scalability and adaptability—as cornerstones of IT flexibility—parallel the notions of reach and richness within the digital options literature (Sambamurthy et al. 2003). A firm that holds digital options has the capability to integrate and connect IT-enabled processes, seamlessly linking activities and sharing information across functional and corporate boundaries (Sambamurthy et al. 2003). IT flexibility creates digital options which, in turn, help to transform how IT aligns with changes in business strategy, thereby allowing firms to be more agile.

While Sambamurthy et al. (2003) claim a direct relationship between digital options and agility, we argue instead for a moderating effect of IT flexibility. A firm's ability to be agile may depend on its starting position—in essence, the current state of alignment. Even if IT flexibility confers digital options on a firm, allowing it to be more agile, the actual attainment of agility will depend on its current state of alignment. If two firms have the same initial level of alignment but have varying levels of IT flexibility, the one with the highest IT flexibility will have more digital options and may, therefore, be expected to attain a higher level of agility. Commensurately, if IT flexibility is similar in each firm but alignment is weaker in one firm than the other, the one with the weakest alignment has more work to do to achieve the same level of agility. These arguments in support of a positive moderating effect of IT flexibility are further illustrated in recent studies on dynamic alignment where the ability of firms to quickly align IT to a revised strategy is found to be enabled or impeded by the presence or absence of IT flexibility (Hirschheim and Sabherwal 2001; Sabherwal et al. 2001). Accordingly,

H3: IT flexibility positively moderates the link between alignment and agility.

Firm Agility and Performance

Agility can improve performance by expanding a firm's repertoire of competitive actions and the nature of its feasible responses to environmental change (Sambamurthy et al. 2003). As argued in the literature on real options, agility gives firms the option to respond to change and to engage in other actions that control market risk and uncertainty (Benaroch 2002; Benaroch et al. 2006; Fichman 2004; Sambamurthy et al. 2003). Agile firms can, therefore, be adjudged to have a wide array of market-response options. Having options in the form of flexible IT infrastructure, a flexible organizational structure, or slack resources allows the firm to be innovative and to actively respond to new market opportunities as they occur (Meyer 1982; Nohria and Gulati 1996). Firms that exercise these options can expect some future benefit in the form of revenues or profitability, cost avoidance, or higher market growth. Accordingly, when firms are better able to react to changes in product demand, to increase the pace of innovation, or to expand into new markets, they are more likely to experience higher profit, reduced costs, and improved market share at a later point in time (Sambamurthy et al. 2003). Therefore,

H4: Agility is positively associated with firm performance.

The Moderating Effect of Environmental Volatility

The link between agility and firm performance can be influenced by the rate of change in the environment. Previous research notes that environmental volatility is a primary contributor to uncertainty and risk in decision making (Child 1972; Dess and Beard 1984). Unexpected market change can compel firms to revise their business strategy. Firms are often forced to rethink their business strategy in the face of incomplete information, as the extent and type of environmental change may not be definite. The option to defer market entry and to wait until market uncertainty has been resolved can be valuable but risky (Fichman 2004). Thus, in a volatile environment, the scale and scope of market threats and opportunities show that there is more downside risk to firm performance from failing to respond in time while there is a greater chance that performance will improve if firms can react faster than their rivals (Meyer 1982). Agility is less of a necessity in a stable setting and so there is less to gain from agility or less to lose from being slow to react. In a stable setting, there are fewer occasions to exercise the options a firm may have to respond to change and so there is less likelihood that agility will have a significant positive effect on firm performance. In a volatile setting, the same degree of agility may have a far higher effect on firm performance due to the higher degree of market uncertainty (Miller and Chen 1996; Miller et al. 1996; Sambamurthy et al. 2003). Accordingly,

H5: Environmental volatility positively moderates the relationship between agility and firm performance.

Research Methodology

The sample frame for this research comprised 1,600 firms, randomly drawn from a population of 2,826 publicly traded firms, identified in S&P Compustat as having 2001 sales ranging from $100 million to $3 billion. Since the focus of our study spans two areas of expertise (IT and business strategy), a matched survey design was adopted. Matched surveys help to limit common method bias while allowing researchers to develop survey items that are tailored to each respondent's domain of expertise. The first survey targeted senior IT executives, identified in the 2002 Directory of Top Computer Executives, while the second survey targeted strategic planners or others with responsibility for business strategy as noted by Hoovers.com, a subscription-based website containing governance data culled from annual reports. Chief financial officers acted as default respondents if persons with business strategy oversight could not be determined. Surveys were independently mailed to each group of executives with independent follow-up.

Matched responses were received from 241 firms (median 2001 sales: $798 million), yielding a 15 percent response rate, a rate that is on a par with matched surveys found elsewhere in the alignment literature (Sabherwal and Chan 2001). An analysis of variance on sales, total assets, and net profit reveals that the 241 firms in our sample are representative of our population. Nonresponse bias was tested by contacting a subsample of nonrespondents in 50 firms (3 percent of our sample frame). Individuals cited travel, confidentiality, and policies precluding participation in academic studies as their reasons for failing to respond; Table 3 presents a synopsis of our overall sample. We next review the constructs and survey measures used to analyze our model; all measures were refined using qualitative feedback derived from a pilot test of IT and business executives in 30 firms.[4]

[4]The 30 firms in our pilot study were research partners of the Center for Research on Information Technology and Organizations at University of California, Irvine. The CIO of each firm critiqued the CIO survey and forwarded the strategic planner survey to a representative individual in their firm.

Table 3. Sample Characteristics (N = 241)		
	Frequency	**Percent**
Revenues (2001)		
Less than $100 million (m)	15	6.2
$100 m - $250 m	75	31.1
$250 m - $500 m	54	22.4
$500 m - $1billion (b)	44	18.3
$1b - $2b	36	14.9
More than $2b	17	7.1
Industry Group		
Electronics and Computing Machinery	65	27.0
Wholesale and Retail	46	19.1
Financial Services	43	17.8
Business and Professional Services	25	10.4
Metals and Plastics	17	7.1
Pharmaceuticals and Healthcare	12	5.0
Other	33	13.6
Respondents		
IT Executive Survey		
Chief Information Officer	116	46.2
IT Director	50	20.7
SVP/VP, Information Technology	49	20.3
IT Manager	26	10.8
Strategic Planner Survey		
SVP/VP Corporate Development	113	46.9
Business Development Officer	60	24.9
VP Strategic Planning	37	15.3
Chief Financial Officer	31	12.9

Strategic IT Alignment

As noted in Table 1, alignment has been measured in a variety of ways, principally in terms of matching, profile deviation, and moderation. There is recent interest in evaluating alignment at the process-level since strategy is executed through a series of business activities and alignment varies from process to process based on differences in strategic focus (Palmer and Markus 2000; Sabherwal and Chan 2001; Tallon 2008). Computing alignment at the process-level calls for process-level measures of both IT and business strategy. Alignment can then be formally modeled using moderation or profile deviation; matching is more suited to measuring alignment at the firm-level (Palmer and Markus 2000). While moderation is criticized for being difficult to interpret, it is easy to compute (Carte and Russell 2003). Profile deviation is more complex as it requires the development of an *ideal* alignment profile that can be difficult to create in practice. What is also attractive about moderation is how, if IT and business strategy are measured at the process-level, moderation scores can be created for each process.[5]

Accordingly, we prepared a series of measures to evaluate IT and business strategy at the process-level. Using the value chain as a generic outline of the processes in a firm (Porter 1985), Tallon (2000) created a 25-item survey to identify the extent to which various activities had been implemented in

[5]While our later analysis is based on moderation scores, as a robustness check, we also considered profile deviation using the approach described in Tallon (2008). This approach uses the same IT and business strategy items used to form moderation scores. The results from modeling alignment as profile deviation are structurally similar to those obtained when modeling alignment using moderation.

Table 4. Critical Business Activities Within the Value Chain

Business Processes	Illustrative Business Activities (Chan et al. 1997; Tallon 2000)
Supplier Relations (inbound logistics)	Developing closer links with suppliers; monitoring product and service quality, monitoring delivery times; gaining leverage over suppliers; negotiating product pricing and service terms
Production and Operations	Improve production throughput; boost labor productivity; improve flexibility and equipment utilization; streamline operations
Product and Service Enhancement	Embed IT in products; increase the pace of development and R&D; monitor design costs; improve quality; support innovation
Sales and Marketing Support	Spot market trends; anticipate customer needs; build market share; forecast market demands; evaluate pricing options; monitor discounts
Customer Relations (outbound logistics)	Respond to customer needs; provide after-sales service and support; improve distribution; create customer loyalty

each of five primary processes: supplier relations (inbound logistics), production and operations, product and service enhancement, sales and marketing support, and customer relations (outbound logistics). Based on reliability and validity analysis in that study and the results of our pilot study, we collapsed the 25 items down to 5 items, 1 per process. As shown in Table 4, respondents (namely strategic planners or CFOs if a strategic planner did not exist) were shown a list of typical activities performed within each process and then asked to rate the extent to which these activities were implemented within their firm on a seven-point Likert scale anchored on not implemented and fully implemented. The text of all survey items appears in the Appendix.

Next, to assess IT strategy, which we operationalized as the extent of IT use in supporting business activities, we developed a matching five-item construct—one IT use item per process—targeted at CIOs. Respondents were shown a list of the same activities as strategic planners. Data were then collected using a seven-point Likert scale anchored on low IT use and high IT use. In combining data on IT use with data on implemented business activities, alignment could then be modeled as a five-item construct, formed by the product of each process-level measure of IT use and its equivalent process-level measure of implemented business activities.

IT Infrastructure Flexibility (Moderator)

As discussed earlier, IT infrastructure flexibility refers to the adaptability and scalability of IT hardware, software, and networks—elements of IT infrastructure. The literature has commonly seen adaptability in terms of *hardware compatibility*, meaning that hardware devices such as servers and routers are interoperable, interchangeable, and compatible with one another so as to enable seamless and rapid data transfer, access, and sharing across functional and corporate boundaries (Byrd and Turner 2000; Duncan 1995). Scalability is typically interpreted as *software modularity* in the sense that features and functions can be added to, or deleted from, software, and *network connectivity* in the sense that applications and devices can seamlessly connect to networks, while networks can also physically scale to connect to users and other IT resources both inside and outside the firm (Byrd and Turner 2000; Duncan 1995).

Based on the results of our pilot study and comments from a panel of three IS academics, we adapted 12 of the 20 survey items used by Byrd and Turner (2000) to assess IT infrastructure flexibility: four items per construct. Given their technical orientation, all IT flexibility items were added to the IT executive survey. Respondents were asked to indicate their agreement with each item on a seven-point Likert scale anchored on do not agree and agree completely.

Agility

While agility refers to the speed with which firms can detect and respond to environmental threats and opportunities, a true test of agility and its implications for performance lies in how easily and quickly firms can revise their behaviors based on unfolding marketplace events (Hitt et al. 1998; Sambamurthy et al. 2003). As noted earlier, Sambamurthy et al. (2003) define agility in terms of customer responsiveness, business partnerships, and operations. From this, we devised a set of eight survey items to assess the ability of firms to easily and quickly change their strategy in each of these three areas. For customer agility, we assess responsiveness to changes in demand, innovation, and pricing. For business partnering agility, we evaluate the adaptiveness of supplier networks. For operations agility, we evaluate response times to new product launches by rivals, market expansion, changes in product mix, and the adoption of new production IT. Pilot

tests and comments from a panel of three academics helped refine our items. All 12 agility items were added to the strategic planner survey with the request that respondents rate their agreement with each item on a seven-point Likert scale anchored on do not agree and agree completely.

Firm Performance

Consistent with studies on IT and firm performance by Bharadwaj (2000) and Santhanam and Hartono (2003), we assess firm performance using three standard financial metrics: return on assets (ROA), net margin, and the ratio of operating income to assets (OI/A). These metrics have been used elsewhere in studies of the performance impacts of IT (Dehning and Richardson 2002; Kohli and Devaraj 2003; Melville et al. 2004). ROA is the ratio of profit to total assets revealing how effectively a firm has used its assets to grow profit levels. Net margin is a standard measure of profitability showing how much net profit is retained from each dollar of revenue. The ratio of operating income to assets is similar to ROA except that the numerator excludes income derived from non-repeated activities such as the gain or loss on the disposal of subsidiaries. Since agility is an ability to detect and respond to change (giving firms, in effect, the option to respond to market change), the benefits of agility are likely to arise in the future. Thus, for the firms in our sample, we use firm performance data from S&P Compustat for 2002 (when the survey was administered) and the next two years: 2003 and 2004. Each measure was then averaged over the three year period for inclusion in our empirical analysis.

Environmental Volatility (Moderator)

While earlier research has assessed environmental volatility using a series of perceptual items focused on product obsolescence, market trends, and new forms of competition (Miller and Friesen 1983), we created a set of objective measures from studies of industry clockspeed (Mendelson and Pillai 1998). Clockspeed is a synonym for market volatility as indicated by values such as the length of a product/service life cycle, the number of annual product launches, the frequency and extent of pricing changes, customer turnover, and the percentage of sales generated from newly launched products or services (Fine 1998). Clockspeed measures have the potential to yield detailed operational insights that measures of environmental dynamism overlook (Boyd 1995; Dess and Beard 1984; Keats and Hitt 1988). Hence, we adapted three clockspeed measures from Mendelson and Pillai (1998): the percentage of sales from products or services launched in the last two years, the percentage change in customer turnover in the last year, and the life cycle duration (in months) for a flagship product or service.[6] Each item was added to the strategic planner survey.

Data Validation and Analysis

To evaluate the robustness of the various survey items distributed across both surveys, we first performed a confirmatory factor analysis in PLSGraph. Since our survey items were adapted from earlier research, a confirmatory factor analysis was favored over more exploratory methods. While PLSGraph reports factor loadings directly, cross-loadings are assessed by correlating outer model weights with the standardized measures of each item. The results of this analysis, together with descriptive statistics for all survey items, appear in Table 5.

We also tested each construct for convergent and discriminant validity. Convergent validity resolves if the indicators of a factor correlate higher among themselves than with indicators of a different factor, while discriminant validity determines if the indicators of a specific factor load higher on that factor than elsewhere. To test both forms of validity, the correlation between each factor-pair must be less than the square root of the average variance extracted for each factor. As shown in Table 6, each factor is found to be valid. We also report that composite reliability comfortably exceeds a suggested minimum of 0.80 for each construct (Werts et al. 1978).

Although IT flexibility was assessed using 12 items, the factor analysis results allow us to model IT flexibility as a second-order factor with 3 first-order reflective indicators: hardware compatibility, software modularity, and network connectivity. Each first-order factor is based on a weighted sum of PLS outer model weights and the standardized survey measures. We next used mean centering on all process-level alignment measures and on the IT flexibility factors as a way to minimize the risk of multicollinearity (Carte and Russell 2003; Chin et al. 1996). As noted by Chin et al. (1996), moderation can then be modeled using a main and interaction effect; the main effect linking IT flexibility to agility need not be interpreted directly. Instead, moderation may be estimated via a single path linking the interaction effects between IT flexibility and alignment to agility. Interaction effects can be modeled by multiplying each of the 5 process-level measures of alignment by each of the 3 first-order IT flexibility weighted averages to create a construct with 15 reflective product indicators (Chin et al. 1996).

[6]Focusing on a flagship product or service is an attempt to detect changes in products or services that constitute the lion's share of revenues in firms.

Table 5. Survey Item Descriptive Statistics and Confirmatory Factor Loadings

	Items	Mean	S. D.	HC	SM	NC	AL	AG	FP
Hardware Compatibility (HC)	HC1	3.74	1.69	0.847	0.557	0.476	0.375	0.305	0.186
	HC2	4.09	1.76	0.867	0.646	0.608	0.378	0.329	0.176
	HC3	4.83	1.70	0.679	0.448	0.449	0.358	0.377	0.073
	HC4	3.95	1.60	0.678	0.484	0.435	0.343	0.380	0.099
Software Modularity (SM)	SM1	4.27	1.52	0.555	0.757	0.568	0.266	0.354	0.080
	SM2	4.22	1.93	0.573	0.827	0.573	0.269	0.358	0.012
	SM3	4.41	1.54	0.585	0.906	0.689	0.361	0.406	0.075
	SM4	4.07	1.59	0.581	0.795	0.647	0.386	0.430	0.055
Network Connectivity (NC)	NC1	5.32	1.47	0.456	0.585	0.835	0.393	0.355	0.048
	NC2	5.00	1.60	0.470	0.606	0.820	0.385	0.286	0.010
	NC3	5.06	1.66	0.539	0.593	0.762	0.312	0.276	0.123
	NC4	3.96	1.83	0.588	0.627	0.776	0.436	0.386	0.109
Alignment (AL)	SR	0.43	0.22	0.218	0.141	0.245	0.665	0.278	0.081
	PO	0.56	0.21	0.329	0.338	0.351	0.584	0.404	0.089
	PSE	0.40	0.23	0.390	0.319	0.371	0.759	0.417	0.135
	MS	0.40	0.23	0.370	0.308	0.335	0.752	0.328	0.115
	CR	0.47	0.23	0.359	0.291	0.400	0.788	0.343	0.047
Agility (AG)	AG1	4.73	1.28	0.314	0.318	0.281	0.393	0.619	0.039
	AG2	5.04	1.57	0.201	0.239	0.194	0.120	0.549	0.040
	AG3	4.48	1.17	0.343	0.387	0.287	0.359	0.772	0.054
	AG4	5.33	1.28	0.201	0.266	0.282	0.313	0.547	0.036
	AG5	4.59	1.57	0.272	0.287	0.266	0.255	0.610	0.094
	AG6	4.55	1.35	0.281	0.339	0.281	0.344	0.702	0.009
	AG7	4.29	1.32	0.389	0.369	0.323	0.436	0.747	0.029
	AG8	4.78	1.42	0.239	0.178	0.172	0.277	0.564	0.040
Firm Performance (FP)	ROA	2.75	25.10	0.163	0.052	0.084	0.161	0.008	0.921
	Margin	3.95	42.83	0.177	0.071	0.087	0.109	0.012	0.983
	OI/A	2.77	28.20	0.176	0.071	0.085	0.109	0.013	0.983

Values in bold indicate primary factor loadings. Alignment is independently measured in each of five processes within the value chain: supplier relations (SR), production/operations (PO), product/service enhancement (PSE), marketing and sales (MS), and customer relations (CR). See the Appendix for survey items.

Table 6. Construct Validity and Reliability

Constructs	Composite Reliability	1.	2.	3.	4.	5.	6.
1. Hardware Compatibility	0.859	0.78					
2. Software Modularity	0.897	0.49	0.83				
3. Network Connectivity	0.881	0.44	0.45	0.81			
4. Alignment	0.837	0.47	0.39	0.48	0.71		
5. Agility	0.862	0.41	0.48	0.44	0.49	0.67	
6. Firm Performance	0.974	0.18	0.07	0.09	0.13	0.18	0.96

Values on the main diagonal represent the square root of the average variance extracted. Off diagonal values represent correlations between first-order factor pairs.

Table 7. Environmental Volatility: Subgroup Analysis of Variance			
	Firms in Stable Settings (N = 134)	**Firms in Volatile Settings (N = 107)**	**F (sig.)**
Rate of annual customer turnover (%)	9.9	17.0	14.882 ***
Revenues from newly launched products and services (%)	24.6	50.0	44.682 ***
Duration of flagship product or service life cycle (months)	70.7	28.2	9.733 ***

***$p < 0.001$

The inclusion of environmental volatility in our model as a moderator of the link between agility and firm performance proved more difficult since our three clockspeed measures (percent of sales from products or services launched in the last two years, percentage change in customer turnover in the past year, and the life cycle duration (in months) for a flagship product or service) use very different scales. As reported in the literature, moderation in these instances can be tested using subgroup analysis; the moderator is used to split the sample into smaller subgroups. Each model may be tested independently and their path estimates compared (Carte and Russell 2003).

Using the three clockspeed measures shown above, we use cluster analysis (k = 2) to break our sample into two groups – low clockspeed firms that operate in a stable environment and high clockspeed firms that operate in a volatile environment. As noted in Table 7, a one-way ANOVA verifies that there are significant differences between each group on each measure. Although this sample-split approach reduces the variance in the moderator, it does not undermine our ability to test for moderation effects in the model (Cohen et al. 2003; Hardy 1993; Podsakoff et al. 1995).

Model Estimation and Results

We estimate seven models in PLSGraph. The first three models intend to test H1 through H4. Model 1 is a baseline model that predicts firm performance for the full sample using controls for industry (using the six sectors in Table 3), company size (the log of 2001 sales), and entropy. Controlling for entropy isolates the effect of firms operating in multiple and potentially unrelated lines of business as agility can vary from one line of business to the next (Palepu 1985). Model 2 builds on model 1 by including all paths in the model, but excluding the moderating effects of IT flexibility. Model 3 includes IT flexibility as a moderator. The results of these three models are shown in Table 8. Reflective indicators apply throughout. Significance levels were computed in PLSGraph using 1,000 bootstrap samples. As a reminder, the expected sign of each hypothesis is identified in parentheses.

In terms of the full model (model 3), we notice first that alignment has no direct effect on firm performance (β = –0.080, *NS*; H1 is not supported). However, if we consider the mediation effects of agility, the indirect effect of alignment on firm performance is significant as indicated by a Sobel test (2.769, $p < 0.01$). As Kenny (2010) explains, to identify whether agility completely or partially mediates the link between alignment and firm performance, we can look at the direct effect when the mediator is removed from the model. As seen in Table 8, when this happens, the direct effect of alignment on firm performance turns from insignificant to positive and significant ($\beta = 0.231$, $p < 0.01$). This means that alignment is positively associated with performance but only insofar as alignment helps agility and agility, in turn, contributes to higher firm performance. Perhaps most interesting of all, our analysis reveals that alignment has a positive and significant effect on agility ($\beta = 0.36$, $p<0.001$), the implication being that alignment helps rather than hurts agility (H2a is supported; H2b is not supported). We note also that IT flexibility fails to moderate the link between alignment and agility so firms should not expect greater agility from aligning IT and business strategy in the presence of flexible IT (β = –0.06, *NS*; H3 is not supported). Testing for moderation involved estimating a main effect of IT flexibility on agility. Although we did not specify a hypothesized relationship between IT flexibility and agility, it is interesting to note that the extent of the effect of IT flexibility on agility is as large as the effect of alignment on agility. This finding is consistent with theoretical arguments outlined in Sambamurthy et al. (2003) as to the role of digital options in creating agility. Regardless of whether alignment is high or low, the quest for improved agility can be advanced by having more flexible IT resources. Lastly, we note that agility has a positive effect on firm performance ($\beta = 0.206$, $p < 0.001$; H4 is supported).

Models 4 through 7 in Table 9 are used to assess the moderating effects of environmental volatility on the link between agility and firm performance (H5). By testing the difference in the relevant agility–performance coefficients for firms in stable and volatile settings, a determination can be made as to the effects of environmental volatility. Models 5 and 7 include

Table 8. PLSGraph Model Results (Standardized Path Estimates; N = 241)

	Model 1 Controls Only	Model 2 Excluding IT Flex.	Model 3 Full Model
Controls	Entropy ^{NS} Industry ^{NS} Size ^{NS}	Entropy ^{NS} Industry ^{NS} Size ^{NS}	Entropy ^{NS} Industry ^{NS} Size ^{NS}
Alignment → Firm Performance **H1** (+) Not supported		0.068 ^{NS} *0.086*	–0.080 ^{NS} *0.082*
Alignment → Agility **H2a** (+) vs. **H2b** (–): H2a Supported		0.426*** *0.045*	0.360*** *0.060*
IT Flexibility → Agility Main effect (IT Flexibility x Alignment) → Agility Interaction effect: **H3** (+) Not supported			0.368* *0.158* –0.060 ^{NS} *0.153*
Agility → Firm Performance **H4** (+) Supported		0.183** *0.070*	0.206*** *0.066*
Explained Variance: R^2 Firm Performance ΔR^2 [F (10, 228) = 3.098***] Agility ΔR^2 [F (3, 235) = 19.613***] Statistical Power	2.2%	13.9% 11.7% 18.1% 0.991	13.9% 34.5% 16.4% 0.991
Test of Mediation Effects: Sobel Test of Agility as Mediator Alignment → Firm Performance (direct path only, omitting the mediator)			2.769** 0.231** 0.091

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. NS: not significant; standard error terms are shown in italics. We report the main effect of IT Flexibility on Agility for reference. This path is added to the model in order to model IT flexibility as a moderator of the link between alignment and agility. While not ordinarily interpreted as part of a moderation test, the main effect is still open to interpretation on its own merits.

Table 9. Environment as Moderator (Standardized Path Estimates)

	N = 134 Model 4 Stable Environ.	N = 134 Model 5 Stable Environ.	N = 107 Model 6 Volatile Environ.	N = 107 Model 7 Volatile Environ.	Model 5 vs. 7 Difference in Coefficient
Controls	Entropy ^{NS} Industry ^{NS} Size ^{NS}	Entropy ^{NS} Industry ^{NS} Size ^{NS}	Entropy ^{NS} Industry ^{NS} Size ^{NS}	Entropy ^{NS} Industry ^{NS} Size ^{NS}	
Alignment → Firm Performance	0.014 ^{NS} *0.112*	0.011 ^{NS} *0.110*	0.207* *0.101*	0.206* *0.097*	0.195 ^{NS} *0.147*
Alignment → Agility	0.142* *0.067*	0.144* *0.068*	0.336*** *0.054*	0.374*** *0.088*	0.230** *0.111*
IT Flexibility → Agility Main Effect (IT Flexibility × Alignment) → Agility Interaction Effect		0.291 † *0.162* 0.037 ^{NS} *0.228*		0.450*** *0.140* 0.211*** *0.055*	0.159 ^{NS} *0.214* 0.174 ^{NS} *0.234*
Agility → Firm Performance **H5** (+) Supported	0.160*** *0.056*	0.156*** *0.050*	0.291*** *0.064*	0.277*** *0.052*	0.121 † *0.072*
Explained Variance: R^2 Agility ΔR^2 F (sig.) Firm Performance Statistical Power	5.9% 18.4% 0.991	23.2% 17.3% 9.611*** 18.4% 0.991	11.3% 25.3% 0.960	37.3% 26.0% 13.961*** 25.3% 0.960	
Test of Mediation Effects: Sobel Test of Agility as Mediator Alignment → Firm Performance (direct path only, omitting the mediator)	 0.171* *0.084*	1.752 † 0.171* *0.084*	 0.251** *0.092*	3.322*** 0.251** *0.092*	 0.080 ^{NS} *0.124*

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; $^{\dagger}p < 0.10$. NS: not significant; standard error terms are shown in italics.

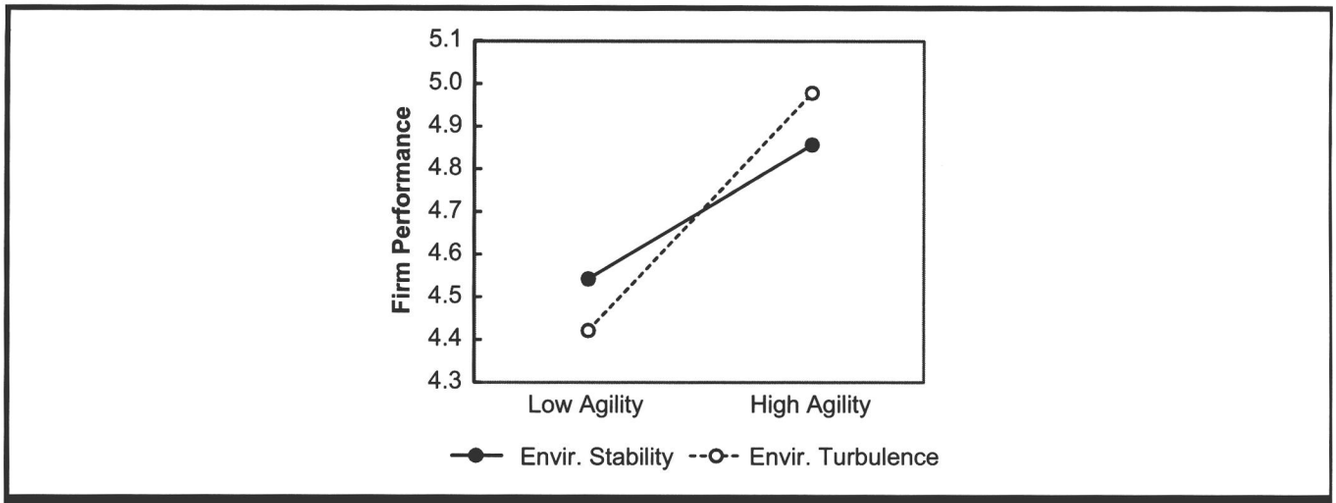

Figure 2. Interaction Plot (Moderation Effects)

IT flexibility as a moderator of the link between alignment and agility; models 4 and 6 exclude IT flexibility. A review of the ΔR^2 shows that the inclusion of IT flexibility in each model enhances our ability to predict agility. As seen in Table 9, we find that environmental volatility positively moderates the link between agility and firm performance (Δ path estimate = 0.121, $p < 0.01$). For completeness, we show path coefficients and significance levels for all paths in Table 9.[7] We note, in particular, that agility mediates the link between alignment and firm performance in both environments. The results of a Sobel test show that the extent of mediation is barely significant in stable settings but is highly significant in volatile settings. Accordingly, the performance implications of alignment in stable settings are less attributable to how alignment shapes agility. Agility is still important in stable settings but firms may have more leeway to spend time evaluating their alternatives before responding to change. Firms in volatile settings have less latitude to delay and so it is not unusual to see agility acting as a very significant mediator. We further note a significant difference in the scale of the link between alignment and agility in both settings (Δ path estimate = 0.23, $p < 0.01$). Alignment helps agility in each instance, but alignment in volatile settings is associated with even higher agility. Given the need for agility in a volatile setting, firms may have greater opportunity to leverage shared knowledge to move the firm in a new direction and may be equally mindful of the need to position resources close to the locus of change. Finally, agility is positively related to firm performance in both stable (β = 0.156, $p < 0.001$) and volatile settings ($\beta = 0.277$, $p < 0.001$).

The addition of an interaction plot in Figure 2 graphically illustrates the interaction effects of environmental volatility on the link between agility and firm performance. In volatile settings, firms see a performance premium from higher agility or, commensurately, a performance penalty if agility is absent. While agility is associated with higher performance in stable settings, the gain in performance attributable to agility is not as high as in volatile settings. By the same token, the penalty attributable to a lack of agility is not as severe. Clearly, for firms in volatile settings, time is of the essence; any delay in responding to change can have dire implications for performance.

Discussion

The IS literature repeatedly shows that alignment between IT and business strategy is an important and enduring source of value, a fact that is not lost on executives who continue to see alignment as a priority (Luftman and Ben-Zvi 2010). The objective of this research was to extend our understanding of alignment and its implications, principally in resolving the issue of whether alignment helps or hurts agility. We do this by embedding alignment and agility in a nomological network

[7] In its totality, Table 9 can be viewed as a moderated-mediation analysis (Edwards and Lambert 2007). Although Edwards and Lambert (2007) indicate a number of empirical challenges to evaluating moderation in a mediated relationship using a subgroup approach, the varied nature of our three clockspeed measures supports a subgroup approach. Following suggestions in Carte and Russell (2003) for testing moderation in subgroups, we use Box's M to test for equality of covariances between each subgroup in models 5 and 7. An insignificant F test ($p = 0.729$) reveals that both subgroups are statistically similar in terms of factor loadings, thereby allowing a more informed interpretation of the moderation results reported for environmental volatility in Table 9.

leading to firm performance. We also investigate the context within which alignment might help or hurt agility by investigating the moderating effects of IT infrastructure flexibility on the link between alignment and agility and the broader effects of market volatility.

Overall, our results show that alignment enables rather than hinders agility, casting doubt on some claims in the literature that alignment impedes agility and that firms may need to accept less than perfect alignment between IT and business strategy in order to remain agile (Ghemawat and del Sol 1998; Jarvenpaa and Ives 1994; Miller 1992). A positive link between alignment and agility applies to all firms, regardless of market volatility. Our results also note a significant main effect of IT infrastructure flexibility on agility (added in order to test the moderation effects of IT infrastructure flexibility on the link between alignment and agility). Taken together, these results suggest that alignment and IT infrastructure flexibility can behave as complementary capabilities that facilitate agility. Research shows that alignment benefits from knowledge sharing among IT and business executives and a shared understanding of the role and capabilities of IT (Preston and Karahanna 2009). As such, IT and business managers are more apt to sense market opportunities or threats and to build a consensus around how best to react. In a sense, alignment can be thought of as a *sensing* capability. If IT infrastructure is scalable or adaptable, firms may be better able to implement their market response strategy with ease, speed, and dexterity, and so IT infrastructure flexibility could be viewed as a *response* capability.[8]

While previous studies represent alignment as having a direct effect on firm performance, we instead examine a nomological network in which agility mediates the link between alignment and firm performance. Overall, our results show that agility fully mediates the link between alignment and firm performance. When we later split our sample into two subgroups as a way to test the moderating effects of environmental volatility, we find that the direct effect of alignment on firm performance is positive for firms in volatile settings only. Sobel tests indicate that agility completely mediates the link between alignment and firm performance in stable settings and is a partial mediator in volatile settings. This finding goes beyond prescriptive advice in the literature for firms to tighten alignment in order to increase firm performance. Our results do not contradict this advice. Rather, we show that the value of alignment is a function of whether it enables firms to be more agile in responding to market-based threats and opportunities. Prior research has also considered the effects of alignment in terms of historical measures of financial performance. Yet, our results show that alignment is as much about future firm performance (affected by agility and the pace of responsiveness to change) as it is about past performance. Our results also reveal that agility is positively associated with firm performance, especially in markets where a rapid rate of change can extend the losses due to a lack of agility or augment the benefits from being agile.

Prior research shows that alignment matters to firm performance; our results help explain *why* alignment matters. Firms align IT and business strategy in order to direct key IT resources to where they can support the strategic needs of the business and to apply existing IT capabilities to discover new business opportunities (Tallon 2008). The fact that the effects of alignment on firm performance are fully mediated by agility shows that the ultimate value of alignment lies in how alignment prepares firms for change. If alignment remains fixated on supporting the status quo, it can produce little more than competitive parity. If alignment enables firms to shift direction or to pursue a new strategy, alignment could emerge as a critical source of competitive differentiation. Agility is essential to survival during periods of intense change but alignment might also be seen as essential for firms to extract enduring value from IT following each market change.

Implications, Contributions, and Future Research

Implications for Research and Practice

The identification of agility as a mediator of the link between alignment and performance is an important result at a time when research is trying to uncover new roles of IT and new sources of IT value (Sambamurthy 2000; Sambamurthy et al. 2003). The organizational studies literature is beginning to assess the issue of ambidexterity, reflecting the simultaneous pursuit of exploitation and exploration (Cao et al. 2009; Gupta et al. 2006; He and Wong 2004). Our research suggests that ambidexterity might be a useful lens for thinking about alignment and agility in IS research. The IS literature is also trying to extend the resource-based view of the firm as it applies to IT in different environments and when faced with varying degrees of IT flexibility (Wade and Hulland 2004). Our results show that the relationship between alignment and performance may need to be revisited in light of the fact that it is fully mediated by agility in stable settings and partially mediated by agility in volatile settings. Our results also indicate that IT flexibility provides an added boost to agility in volatile settings, thus highlighting the options value of designing flexible IT in an uncertain market. The direct effect of agility on performance is also higher in volatile settings.

[8]We thank the senior editor for suggesting this interpretation.

In addition, our results highlight an advantage of conceptualizing alignment at the process level. Earlier research finds that the locus of alignment can vary from process to process, depending on the particular strategy a firm has chosen. Alignment may also be more challenging for firms with multiple strategic foci (Tallon 2008). Since alignment and agility are multifaceted (alignment can be evaluated in any one of several business processes while agility can also be considered in the area of operations, customers, and business partners), each can be conceptualized and studied at a disaggregate level. Moving away from a preoccupation with alignment at the firm level can yield a more detailed understanding of the relationship between alignment, agility, and performance.

Our findings are also relevant for IS practice. Alignment remains a priority for executives who are increasingly concerned about agility in light of the rate of change in global markets (Luftman and Ben-Zvi 2010). Contrary to earlier claims of a tradeoff between alignment and agility or between using alignment for short-term performance gains and agility for longer-term gains, our results show unequivocally that alignment is an important source of organizational value because of its link to agility. A combination of tight alignment and flexible IT infrastructure allows firms to use IT in ways that satisfy their short term strategic goals while developing greater knowledge and awareness of how IT can help them react faster to changing markets. Our results suggest that alignment can be a source of competitive advantage if agility is itself a source of differentiation. Consequently, executives can continue to look to alignment as a way to boost firm performance in the short run but with an eye also to how alignment can enable a future advantage. Firms may also look to alignment as a way to develop digital options that can provide them with a means to respond to change; these digital options that can be embedded within a flexible IT infrastructure.

Contributions to Research

This research extends the literature on alignment and agility in three specific ways. First, in outlining two competing theoretical perspectives that alternately predict a positive or negative link between alignment and agility, we aim to resolve an ongoing debate within the IS literature. Our study provides support for the *enabling* perspective and, in so doing, provides fresh insights into the relationship between alignment and agility. Second, we find that alignment and IT flexibility are equally important predictors of agility. While alignment enables executives to find ways for IT to boost agility, IT infrastructure flexibility is what will ultimately implement those ideas. Third, we note that agility completely mediates the link between alignment and firm performance, except in volatile settings where agility is found to be a partial mediator. This helps explain how and why alignment affects performance. While alignment remains a driving force in organizational efforts to improve firm performance, research must take into account the fact that the antecedents of alignment might equally contribute to efforts to enhance agility.

Future Research

Our findings suggest several avenues for future IS research. First, the focus of our sample was firms with under $3 billion in annual sales. While size did not impact our results, large firms could create different results given their propensity for vast resource holdings and the possibility that size could become a barrier to agility. While we controlled for entropy (no effect was noted), large firms with complex strategies could pose special challenges for both alignment and agility.

Second, our data are cross sectional, which limits our ability to observe how firms react to change or the ease and speed with which such responses occur. Prior research by Hirschheim and Sabherwal (2001) and Sabherwal et al. (2001) illustrates the benefit of using longitudinal data to show how firms proceed toward alignment or how failure to understand the pace and direction of change may add to alignment missteps. In particular, it might be interesting to see how alignment enables agility over time and how the success or failure of agility contributes to future alignment decisions. IT flexibility could play a dual role in this relationship: both facilitating the relationship between alignment and agility and as a remedial capability to correct for deficiencies in alignment that might limit agility. In addition, just as there is a lag between when firms invest in IT and when the effects of IT flow through to the financial statements, there may also be a lag between attempts to deliver improved alignment and the time when the effects of alignment flow through to agility. Knowing the dynamics of this relationship may be important to firms that are faced with the sudden onset of a changing environment. If the effects of alignment on agility are delayed, future research could help to consider how these effects could be accelerated.

Conclusion

At a time when firms are facing tremendous change and uncertainty in their products and markets, agility is seen as a key competitive imperative. Anecdotal evidence suggests that firms that are agile will survive and thrive but those that fail

to adapt will struggle and die (Ross et al. 2006). Arguments abound that IT plays a role in providing agility. However, with IT investment cycles stretching over extended periods and with long project payback periods, there is an uneasy feeling among executives that certain forms of strategic IT alignment may start to impede agility.

Our research reveals that alignment is a potent source of value and worthy of the priority status consistently afforded it by top executives (Luftman and Ben-Zvi 2010). More importantly, contradicting earlier claims in the IS literature, our results show that firms do *not* face a tradeoff between near-term alignment and longer-term agility. Strategizing for agility is a useful exercise for firms facing unexpected and potentially disruptive market events (Galliers 2007; Sambamurthy 2000). Our results suggest that alignment could become a key part of how firms strategize for and justify agility as part of an attempt to protect and, longer term, to improve their performance.

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Appendix

Survey Items and Constructs

Business Strategy (Process Level)

For each business process, please consider the critical business activities on the right, and identify the extent to which these activities have been implemented by your firm (1: Not implemented; 7: Fully implemented).

Supplier Relations	Forge closer links with suppliers; monitor quality; monitor delivery times; gain leverage over suppliers; negotiate pricing.
Production/Operations	Improve throughput, boost labor productivity, improve flexibility and equipment utilization; streamline operations.
Product and Service Enhancement	Embed IT in products; increase pace of development / R&D; monitor design cost; improve quality; support innovation.
Sales and Marketing Support	Spot market trends; anticipate customer needs; build market share; improve forecast accuracy; evaluate pricing options.
Customer Relations	Respond to customer needs; provide after-sales service and support; improve distribution; create customer loyalty.

Agility

How easily and quickly can your firm perform the following actions? (1: Do not agree; 7: Agree completely)

- Respond to changes in aggregate consumer demand.
- Customize a product or service to suit an individual customer.
- React to new product or service launches by competitors.
- Introduce new pricing schedules in response to changes in competitors' prices.
- Expand into new regional or international markets.
- Change (i.e., expand or reduce) the variety of products / services available for sale.
- Adopt new technologies to produce better, faster and cheaper products and services.
- Switch suppliers to avail of lower costs, better quality or improved delivery times.

Environmental Volatility

Please complete the following for a flagship product or service sold by your firm.

- Average length of the life cycle of the product or service (in months).
- What % of customers is turned over (i.e., lost or replaced) in a year?
- What % of sales comes from products or services launched in the last 2 years?

IT Flexibility

To what extent do you agree with the following statements? (1: Do not agree; 7: Agree completely)

Hardware Compatibility

- Software applications can be easily transported and used across multiple platforms
- Our user interfaces provide transparent access to all platforms and applications
- Our firm offers multiple interfaces or entry points (e.g., web access) to external users
- Our firm makes extensive use of middleware to integrate key enterprise applications

Software Modularity

- Reusable software modules are widely used throughout our systems development unit
- Legacy systems within our firm do not hamper the development of new IT applications
- Functionality can be quickly added to critical applications based on end-user requests
- Our firm can easily handle variations in data formats and standards

Network Connectivity

Our company has a high degree of systems inter-connectivity
Our systems are sufficiently flexible to incorporate electronic links to external parties
Remote users can seamlessly access centralized data
Data is captured and made available to everyone in the firm in real time

IT Use (Process Level)

To what extent is IT used to support key business activities in each of the following business processes? (1: Low IT Use; 7: High IT Use)

Supplier Relations	Production and Operations	Customer Relations
Product and Service Enhancement	Marketing and Sales	